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A COMPARATIVE ANALYSIS OF TEACHER AND NONTEACHER SALARIES IN THE PROVINCE OF ALBERTA

by

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Comparative Analysis of Teacher and Nonteacher Salaries in the Province of Alberta," submitted by Gerald Kingman Palmer, in partial fulfillment of the requirements for the degree of Master of Arts.

ABSTRACT

The purpose of this study is to make comparisons between the salaries of public school teachers and the salaries of people in selected nonteaching occupations. To achieve this purpose, sample data were gathered from Alberta employers in these two categories in the spring and summer of 1961. Salary comparisons were made only between subgroups whose members were of the same sex and who had equivalent amounts of training and experience.

To effect the comparison, the mean salary for each subgroup was calculated. The means of equivalent teacher and nonteacher subgroups were then compared using the "t" test in order to determine if they were significantly different at the 95% level of confidence. When differences proved significant, the 95% confidence interval of the differences was calculated and tabled.

From the foregoing, it was concluded that in general, male nonteachers earned more than male teachers, while the reverse was true for females.

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CHAPTER I

INTRODUCTION

Origin and Purpose of Study

Since 1955, teachers' salaries in Alberta have increased rapidly. Between 1955 and 1960, the average teacher salary rose about 40%[1], and this upward trend has continued. In response to this continuing economic phenomenon, the Alberta School Trustees Association initiated a broad-scale study on the factors affecting the supply and demand of teachers in the province; Dr. Eric F. Hanson of the University of Alberta was engaged to carry it out.

This study is intended as an extension of the report prepared and submitted by Dr. Hanson. Whereas the Hanson report discusses salaries in broad terms using aggregate data, this study, in contrast, has attempted narrower salary comparisons. These comparisons are

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[1]Derived from: Province of Alberta, Department of Education, Annual Reports, by dividing total expenditures on teachers' salaries by the number of teachers.

based on sample data collected from teacher and nonteacher employers in Alberta during the Spring and Summer of 1961.

While this study should prove a useful extension of the Hanson report, the focus of the work has been to develop the data around a statistical format. This was done in part as an exercise in the use of certain statistical techniques as they apply to this type of inquiry and, in part, to improve the precision of the salary comparisons made between teacher and nonteacher groups. Accordingly, this study is both an exploration of statistical procedures and an analysis of differences between teacher and nonteacher salaries.

Overview of the Study

To achieve the above purposes, it was necessary first to develop a working definition of occupational comparability. Next, data consistent with this definition was collected from employers of teachers and selected nonteachers in Alberta. This sample data was then statistically processed so that probabilistic statements on comparative salary levels could be made. Finally, a critique of the method and results was prepared, pointing up the limitations of the study.

The major items in the above approach are organized into chapters in the following manner.

Chapter II deals with the choice and source of the data collected for the study. Specifically it (1) outlines the criteria followed in grouping the data for comparative purposes and (2) describes the source and nature of the data obtained and explains the basis on which it was organized and recorded.

Chapter III deals with the statistical procedures used in the study. Specifically, the measures selected to describe the data are brought out together with a development of the statistical tests applied in the comparisons of teacher and non-teacher salaries. In addition, there is a brief discussion of the assumptions underlying the procedures and how the data relates to these assumptions.

Chapter IV summarizes the results of the statistical tests applied to the sample data. Tables are presented showing (1) the differences found in the comparisons and (2) whether or not these differences can be considered significant. Following each table is a discussion of the interpretations that can be made about the results, given the particular limitations of the sample data.

Chapter V presents an overall evaluation of the study. A critique of the method used is offered, together with suggestions on how the study could be improved. In particular, the question of sampling plans is brought out. A discussion is presented on how the precision and consistency of results can be improved by using a proper plan together with appropriate follow-up methods.

CHAPTER II

THE DATA

The purpose of this study is to determine if significant differences exist between teacher salaries and salaries paid in occupations which can be viewed as broadly comparable to teaching. To achieve this, the following steps were necessary:

1) Develop criteria for the type of data on teachers and nonteachers to be gathered from their employers.
2) Select a sample of employers to provide data on teachers and nonteachers, the data being based on the criteria developed in 1) above.
3) Arrange the sample data into subsamples, based on the criteria developed in 1) above.
4) Process the arranged data statistically and draw appropriate conclusions.

This chapter will deal with the first three steps above; the fourth step is covered in Chapters III and IV.

Criteria Governing the Choice and Grouping of Data

In order to make meaningful comparisons, it was decided to subdivide the broad categories of "teacher" and "nonteacher" into strata such that the resulting groups would be broadly equivalent: (a) in terms of occupational or professional standing and (b) in terms of length of service. Occupations considered equivalent to teaching were those with similar requirements for entry. In teaching, those requirements are usually stated in terms of successfully completed years of formal or university training. In nonteaching, the number of years of training (and, in some instances, sex) is one of the main factors which determine entry. Length of service was defined as "years of experience" that could be considered to exert a direct influence on salary level.

Division as to Sex

This study takes the position that salary comparisons should be made between groups that are broadly equivalent in terms of occupation. For women, occupations equivalent to teaching are still somewhat limited to the more traditional "feminine" areas, e.g., nursing, social

work, stenography, etc. For men, however, the range of occupations equivalent to teaching was much greater, given a decision, for example, to undertake four years of training, a man had a larger number of alternative occupations which he might enter than did a woman. In addition, it was hypothesized that a disparity in salaries within occupations might exist between males and females, even thought their training and length of service were equivalent. Thus, it was decided that a failure to divide the sample into male and female groups could obscure meaningful comparisons between teacher and nonteacher salaries.[1]

Division as to Years of Training

A second primary criterion for occupational comparability used in this study is years of training. It was recognized that, if a person decides to undertake "n" years of formal or university study, he will have a certain number of alternative occupations open to him on the basis of the extent of that study. These alternative occupations are, for the purpose of this study, considered comparable.

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[1]The results of this study lend support to this hypothesis. For example, for the subgroups with equivalent training and experience, the average salaries for males exceeded those for females in all but one case.

This definition permits a comparison between teaching and nonteaching from the point of view,in terms of salary, of the prior decision to undertake the training required to enter a particular field. The teaching profession, for example, normally recognizes from one to six years of training and reflects this recognition in its salary schedules. Likewise, most nonteaching occupations have training specifications and salary schedules that reflect the training required. Some nonteaching professions--e.g., nursing and law--state training requirements clearly; while others, particularly in the semi- and nonprofessional areas, are less definite about training requirements.[2] However, even in semi- or nonprofessional occupations requiring some formal training, there is implicit in the choice of that occupation a prior decision to undertake the specified training. Thus, for example, if teaching, nursing, drafting and stenography all required equal amounts of post-high school training, all would be

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[2]For example, the classification of "draftsman" might require from one to three years of training, depending on a specific job definition.

considered alternative and comparable occupations, according to this criterion.

It should be emphasized that this study does not directly compare specific occupations with teaching; a number of occupations comprise each nonteaching group. Table 1 shows the occupations for which data was gathered, together with their inclusion in "years of training" categories.[3]

Division as to Years of Experience

Whereas the divisions by sex and by years of training are concerned with entry into an occupation, the divisions by years of experience focus on a persons' progress, in terms of salary, within a particular occupation. In teaching, annual raises based on years of experience alone can amount to a 40% to 60% increase in annual

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[3]Some occupational categories include a wide range of training. This suggests that the definition of "occupation" was too loose when the data was gathered. No record was kept on salary by occupation; however, when the data was recorded it was noted that salaries reported were consistent with the corresponding years of training. For instance, when an employer reported the salary for an engineer with one year of training, it was generally clear that the salary reflected the one year level of training and that the term "engineer" was a special classification for that employer.

TABLE 1

OCCUPATIONS SAMPLED SHOWING YEARS OF TRAINING REPORTED

Occupation	Years of Training 1	2	3	4	5	6
Architecture					x	x
Teaching	x	x	x	x	x	x
Drafting	x	x	x			
Technical	x	x	x	x	x	x
Engineering	x	x	x	x	x	x
Chemistry			x	x		
Meteorology	x			x		
Library	x	x	x	x	x	
Social Work	x	x	x	x	x	
Stenography	x	x	x	x		
Clerical	x	x	x	x		
Managing	x	x	x	x	x	x
Accounting	x	x	x	x	x	x
Instructing			x	x	x	x
Nursing	x	x	x	x		
Estimating	x	x	x	x		
Agriculture				x	x	x
Planning				x	x	x
Geology			x	x	x	x
Law					x	x
Dentistry						x
Physiotherapy		x	x	x	x	x
Home Economics			x	x	x	
Dietary			x	x		

salaries over a ten year period. This study assumes that a similar range of increases exists in nonteaching occupations. From this, it follows that, in both teaching and nonteaching, the effect of experience on salary is sufficiently great to warrant subgrouping into experience categories so comparisons might be made on that basis.[4]

In order to increase the size of each subgroup and to reduce the excessive number of comparisons, years of experience were grouped into the following categories:

Group A--0 to 2 years of employment

Group B--2 through 5 years of employment

Group C--6 through 15 years of employment

Group D--16 years and over

These groups were designed to reflect earnings during (a) the initial years of employment, (b) the early years of employment, (c) the early career period, and (d) the

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[4]Results of this study appear to substantiate this grouping; for example, over a thirty year period of employment, the average salary of a male teacher increased by 95% and the average salary of a male nonteacher increased 102%.

late career period. Each group also represents an approximately equal increment in average annual earnings.[5]

Source and Collection of Data

The data used in this study were gathered from various employers, including school boards; manufacturing firms; retailing firms; civic, provincial, and federal governments.

Teacher Data

The data on teacher salaries were obtained from questionnaires mailed to school boards throughout Alberta by the Department of Education and the Alberta School

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[5] An attempt was made to consider a second division related to a person's salary progress within an occupation, i.e., level of responsibility. However, difficulties associated with the definition of such levels made the use of these categories impractical in the subgrouping of the data. In the initial gathering of data, levels of responsibility were defined in terms of categories found in teaching: a) classroom teacher, b) vice-principal, c) principal, d) superintendent. When the data from the nonteaching occupations were received, it was found that the variation within levels so defined was too great to allow for meaningful comparisons. In addition, subgrouping the data into four additional categories made the subsample sizes too small for practical use in the statistical tests applied to the data.

Trustees Association. Salary and other information were obtained from 9,641 persons, including 3,090 males and 6,551 females. This number represented a sample of approximately 76% of the total teaching force of 12,607.[6]

Nonteaching Data

The data on nonteaching salaries were obtained from questionnaires mailed to business and government employers throughout Alberta. Returns provided the necessary information on 4,125 persons of whom 2,609 were males and 1,536 were females.

Table II-2 gives the number of questionnaires mailed and the percentage returned by the employer type and is included here to give the reader some idea of the nature of the nonteaching sample data.

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[6] Province of Alberta, Department of Education, Annual Report, 1961.

TABLE 2

NUMBER OF QUESTIONNAIRES MAILED AND PERCENT RESPONSE BY EMPLOYER TYPE

Firm Type	Number of Questionnaires Mailed	Percentage of Questionnaires Returned & Used
Manufacturing	97	28%
Oil	83	31%
Government	23	79%
Department Store	11	---
Wholesale	79	17%
Automotive	31	13%
Financial	42	33%
Retail	68	13%
Institutions	25	40%
Construction	53	36%
TOTAL	582	24%

Organization of the Data

The incoming data was organized and tabulated into frequency tables which are presented in the Appendix. Each table presents the income data obtained for subgroups in an occupational category with the same sex, training and experience. For example, Table I of the appendix shows male teacher earnings for each of the 6 years of training and for each of the 4 groups of experience.

CHAPTER III

METHOD

This chapter deals with the statistical considerations that arose in this study. In particular, it focuses on: (a) the choice of statistical measures, (b) the underlying assumptions of these measures, (c) the effects of violations of the assumptions, and (d) the compatibility of the data with these assumptions.

Choice of Statistical Measures

To achieve the purpose of this study it was necessary to select a parameter that would effectively represent the salary levels of the teacher and nonteacher populations. The measure selected was the arithmetic mean. It was chosen because it is a generally accepted and well understood measure of average salaries; in addition, the mean is a convenient measure to work with from an algebraic and statistical point of view.

As an estimate of the population mean, the sample mean was selected. It was chosen for two reasons:

(1) it is the most efficient estimator of the population mean,[1] and (2) the distribution of sample means drawn from most populations is known to follow the normal distribution. The latter fact makes it possible, through various statistical methods, to draw inferences about population means and to test hypotheses for possible differences between these means.

To test for significant differences between population means, the "t" test was selected. It was chosen as the most suitable test for drawing inferences from individual paired sub-samples of teacher and nonteacher groups.[2]

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[1]Some authorities recommend the median, arguing that most salary distributions are positively skewed (which is true in this study) so that the median is more representative of the modal, or typical, salary and further that it is not affected by extreme values. In this study, it was felt that the average should reflect extremely high or low salaries, as one of the underlying objectives has been to suggest what might be called salary-opportunity in the different occupations. Secondly, the median was ruled out because it has a higher sampling variance and is therefore a less efficient estimator of central tendency.

[2]An alternative method for testing for significant differences between sample means is the Analysis of Variance. For a discussion of this method see M.J. Moroney, Facts From Figures (3d ed. rev.; Baltimore: Penguin Books Inc., 1956), pp. 371-457.

When the population variances were estimated to be equal,[3] the "t" value was calculated from:

$$t = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{s^2 \frac{n_1 + n_2}{n_1 n_2}}}$$

$\bar{x}_1$ = mean of sample one

μ_1 = assumed mean of population one

$\bar{x}_2$ = mean of sample two

μ_2 = assumed mean of population two

s^2 = pooled variance of the teacher and nonteacher subsample

n_1 = size of sample one

n_2 = size of sample two

This ratio (as do the others that follow) allows one to

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[3]These estimates were based on the results of "F" tests run on each pair of teacher and nonteacher subgroups. The level of significance for this test was set at .05. When calculated "F" values exceeded the tabled values, the inference drawn was that the population variances were dissimilar. In Chapter IV, the results of the "F" tests are presented together with a discussion of their use and application in the study.

test the null hypothesis that $\mu_1 - \mu_2 = 0$, and hence that the difference between $\bar{x}_1$ and $\bar{x}_2$ is a difference that arises from sampling error. If the hypothesis is true, the ratio will yield (in 95% of cases) a "t" value that is between the tabled values for "t" at the .05 level of significance[4] for $n_1 + n_2 - 2$ degrees of freedom.

If the null hypothesis is false, the calculated "t" may or may not prove significant depending on: (a) the extent of the true difference in the population means, (b) the degree of difference in the population variances, and (c) the size of samples.[5]

An example of the "t" calculation when the hypothesis is considered false is provided in the following comparison between male teachers and nonteachers with two years of training and in group B of experience. For

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[4]The level of significance for all "t" tests was set at .05.

[5]This point is covered under the subject "beta error" in most statistical texts: for example, Helen M. Walker and Joseph Lev, Statistical Inference (New York, 1953), p. 60.

these groups, the relevant measures are:

	$\bar{x}$	s	n
Teachers	\$4482	\$607	89
Nonteachers	\$4291	\$533	107

From the "F" test we have $\frac{s_1}{s_2} = \frac{607^2}{533^2} \doteq 1.37$. This value is less than the tabled value which for $n_2 = 100$ and $n_1 = 80$ is 1.42. This suggests that the population variances are similar and that the foregoing "t" formula should be used. This yields a "t" value of 2.28 which exceeds the tabled "t" value of 1.98 for $n_1 + n_2 - 2 = 194$ degrees of freedom. Thus, we conclude that, at the 95% level, the null hypothesis is false and that a difference of \$191 in sample means is too large to support the inference that the samples were drawn from populations with the same mean.[6]

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[6]In another form, the conclusion is that in 95 samples out of 100, one would not expect to get a chance difference as large as \$191. This says nothing about the remaining 5% of samples that could yield a chance difference this large. For $\alpha = .99$, the tabled "t" = 2.33, which is larger than the calculated "t" above. This means that, out of 1000 samples drawn, some will have differences as large as \$191, and that such a difference could occur in 2% of cases even if the population means were identical.

When the population variances were estimated to be unequal, the "t" values were calculated from the ratio:

$$t = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

When samples were greater than 30, this test was based on tabled "t" values at $n_1 + n_2 - 2$ degrees of freedom.

When samples were less than 30, the tabled "t" was determined by degrees of freedom calculated from the following formula:

$$n = \frac{\left(\frac{s_1^2}{n_1} \quad \frac{s_2^2}{n_2}\right)^2}{\left(\frac{s_1^2}{n_1}\right)^2 \frac{1}{n_1 + 1} \quad \left(\frac{s_2^2}{n_2}\right)^2 \frac{1}{n_2 + 1}} - 2$$

In the cases where a significant difference was found from the foregoing "t" tests, a confidence interval around this difference was calculated at the 95%

level. From this statistic, we get a measure of how large the difference in population means is likely to be with this specified degree of confidence. In symbols, this interval sets up as:

$$p\left(t_{.025} \leq \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{s_{\bar{x}_1 - \bar{x}_2}} \leq t_{.975} \right) = .95$$

and is calculated from: $D \pm t\, s_{\bar{x}_1 - \bar{x}_2}$ where:

D = the difference between sample means

t = the tabled "t" value at the 95% level for the appropriate degrees of freedom

$s_{\bar{x}_1 - \bar{x}_2}$ = standard error of the mean difference as used in the "t" test for a given pair of sample means

From the example above, the confidence interval of the mean difference becomes \$191 ± \$166. This is interpreted as follows: the confidence interval

$\$191 \pm \$166$ is our best estimate (based on this sample) of where the true difference is likely to fall.[7]

Underlying Assumptions

The validity of the conclusions to be drawn from the foregoing statistical measures is based on the underlying assumption that sample observations are randomly and independently drawn from normally distributed populations. These assumptions are necessary for the relationships stated to be known exactly; they are based on the following theoretical grounds.

Random and Independent Observations

For the laws of probability to hold in a sampling situation, it is a necessary requirement that every element in a population has an equal chance of being selected (randomness), and that the selection of one

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[7]A more formal statement of this would be that 95% of the confidence intervals generated from paired sample means would span the true value $\mu_1 - \mu_2$.

observation in no way affects the selection of a second observation (independence).

When the characteristics of the population are known, the relationship between sample and population can be established. This is so because only the mechanisms of probability determine sample characteristics.

Normal Populations

The tests and measures used in this study are based on the known relationships between sample and population, when the population is normally distributed. In the case of the "t" ratio, for example, the behavior of both the numerator and the denominator are known exactly if samples are randomly drawn from a normal population.

Effects of Violations of Assumptions

When these two assumptions are not met, the exact behavior of sample statistics is not known and the procedures give results that are only approximations. The accuracy of these approximations will depend on the degree of departure from assumptions and the particular measures under consideration.

For the "t" test there is considerable evidence that the results are quite reliable, even if samples are drawn from non-normal populations with dissimilar variances. This assertion is supported by C.A. Boneau[8] who did some experimental work with "t" distributions in which he purposefully violated the assumptions of the "t" test. In the experiment, he drew samples of $n = 5$ and $n = 15$ from normal, exponential and rectangular populations. First, populations were paired with equal and dissimilar variances in ratio of 4 to 1. Then, "t" values were calculated for 1000 and 2000 cases, with the percent of cases recorded that fell outside the region of acceptance at the 95% level.

His results can be summarized as follows:

1. When samples of size five and fifteen were drawn from normal populations with equal variances, the empirical distributions were not significantly different from the theoretical "t" distributions.

2. When samples of size five were drawn from normal populations with unequal variances in the ratio of 4:1, a slight departure from the theoretical "t"

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[8]Boneau, C.A., "The Effects of Violations of Assumptions Underlying the t Test." Psychological Bulletin, LVII (1960), pp. 49-64.

occurred (1.4%); however, when samples were increased to fifteen, the approximation was almost perfect.

3. When samples of size five and fifteen were drawn from normal populations with unequal variances in the ratio of 4:1, a significant departure from the theoretical curve occurred. When the small sample (5) was associated with the smaller variance, only 1% of the empirical values fell beyond the five percent limits of the theoretical curve. However, when the small sample was associated with the larger variance, 16% of the calculated "t"'s fell outside the 5% limits.

4. When the above arrangements of variance and sample size were applied to the samples drawn from non-normal populations (exponential and rectangular), the results were patently similar to samples drawn from normal populations. Boneau concludes as follows:

> "By the time sample sizes reach 25 or 30, the approach (to the theoretical nominal values) should be close enough that one can ignore the effects of violations of assumptions except for extremes."[9]

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[9]Boneau, loc. cit., p. 63.

Compatibility of the Sample Data

In this study, it is likely that the populations under consideration are not normally distributed. This is suggested by the shape of the sample distributions, all of which have a positive skew. However, in no case does it appear that the underlying population distributions would be as non-normal as those studied by Boneau. This suggests that, insofar as the shape of the distributions are concerned, the "t" tests used in this study should give useful results in analyzing any differences that were observed in the data.

With respect to sample sizes and estimated population variances, certain subgroups have disparities in these quantities that are at or beyond the extremes cited by Boneau. In these instances, the results of the "t" test are likely to be unreliable. In particular, this conclusion applies when the test indicates nonsignificance even though large differences are present. In these cases it will usually be found that disproportionately small samples are associated with disproportionately large sample variances. An example of this

occurs in the subgroups of male teachers and nonteachers with 6 years of training and Group D of experience. In this example, the sample variances are in the ratio of 5:1,and the sample sizes are in the ratio of 10:1. The larger variance (nonteachers) is associated with the smaller sample (size 21); this suggests that, in this case, the result would come under item 3 in Boneau's conclusions noted above.[10]

Finally, it is likely that the nonteacher samples obtained for this study contain a bias due to non-respondents. In gathering the data, a conscientious attempt was made to obtain as much information as possible from all sources. However, no follow-up procedure was used to determine the nature of the populations represented by the non-respondents. Instead, an analysis of the replies was made which indicated that the non-respondents were mainly in two categories: (1) traditionally low paying employers such as department stores and (2) traditionally high paying positions such

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[10]Further instances where this condition appears to exist will be noted in Chapter IV.

as executive and chief engineers. The result is that no positive statement can be made as to the representativeness of the nonteacher data.

With respect to the teacher data, the total sample included almost 80% of the teacher population. This high proportion, together with the fact that the non-respondents appeared to be randomly distributed throughout the province, suggests that little bias is present in the teacher sample.

CHAPTER IV

RESULTS

This chapter contains a presentation and discussion of the results of the statistical calculations. The tables show the relevant statistics for each subgroup of teachers and nonteachers, while the discussions are keyed to interpreting and evaluating the results so presented. Particular attention is given to those results which could be of practical interest to a non-technical reader.

Each of the four subsections of this chapter focuses on a particular statistical measure. Explanation of the purpose of each test is followed by a description of how its results should be interpreted; finally, the statistically significant results are highlighted. These subsections focus on the following:

The mean salaries and their confidence intervals: Tables 3 through 11.

Variance ratio tests and coefficients of variation: Tables 12 through 18.

The mean differences between subgroups and their significance: Tables 19 through 20.

The confidence intervals of the mean differences: Tables 21 through 22.

For ease of interpretation and discussion, the tables should be regarded as being made up of cells that relate experience groupings and years of training. It will be recalled from Chapter II that years of experience were grouped as follows: (1) Group A, 0-1 years; (2) Group B, 2-5 years; (3) Group C, 6-15 years; and (4) Group D, over 15 years. Thus, in the discussion, reference will be made to cells; for example, cell 1-B will refer to the group with one year of training and in Group B of experience.

<u>Mean Salaries and Their Confidence Intervals</u>

The sample means and their confidence intervals are included in this chapter in order to provide a frame of reference for both the level of salaries and the reliability of the mean estimates.

Means

As explained in Chapter III, the sample means are a "best estimate" of the population means. While these measures do not bear directly on the main purpose of the study (i.e., comparisons of teacher and non-teacher salaries), they do provide a useful description of the level of salaries involved, as well as how those levels change from group to group.

Confidence Intervals

The confidence intervals presented in this section measure the degree of reliability that exists for each of the mean salary estimates calculated from sample sub-groups. More specifically, the size of the confidence interval suggests the degree of assurance one can have in drawing inferences from the data. The size of these intervals are presented in two forms: absolute and relative.

Tables 3 through 6 present the intervals in absolute, or dollar, terms. Thus, in the case of male teachers with four years of training and in Group A of

TABLE 3

MEAN SALARIES AND CONFIDENCE INTERVALS FOR MALE TEACHERS (STATED IN DOLLARS)

Years of Training	Years of Experience							
	0-1		2-5		6-15		16 and over	
	Mean	Interval	Mean	Interval	Mean	Interval	Mean	Interval
1	3142	± 48	3788	± 68	4650	± 93	5237	±193
2	3656	± 56	4482	±113	5438	±101	6088	±205
3	4133	±118	5098	±164	6317	±152	6749	±154
4	4892	± 51	5716	±100	7325	± 93	8172	± 93
5	5342	± 73	6138	±144	7862	±105	8695	±130
6	5569	±159	6532	±259	8523	±211	9457	±153

TABLE 4

MEAN SALARIES AND CONFIDENCE INTERVAL FOR MALE NONTEACHERS (STATED IN DOLLARS)

	Years of Experience							
	0-1		2-5		6-15		16 and over	
Years of Training	Mean	Interval	Mean	Interval	Mean	Interval	Mean	Interval
1	3059	± 92	4020	± 88	5598	±173	7080	± 529
2	3547	±198	4291	±120	5374	±214	5620	±1024
3	4416	±461	5159	±300	6607	±291	7082	± 312
4	4912	±193	6158	±108	8244	±150	8943	± 461
5	5520	±648	6550	±538	8263	±412	9147	±1101
6	7175	±457	7690	±365	9626	±521	10048	±1209

TABLE 5

MEAN SALARIES AND CONFIDENCE INTERVALS FOR FEMALE TEACHERS (STATED IN DOLLARS)

	Years of Experience							
	0-1		2-5		6-15		16 and over	
Years of Training	Mean	Interval	Mean	Interval	Mean	Interval	Mean	Interval
1	3062	± 16	3581	± 19	4414	± 20	4846	± 34
2	3483	± 34	4058	± 49	5054	± 50	5591	± 73
3	3968	±108	4710	±133	5675	±147	6463	±136
4	4820	± 52	5434	± 68	6691	±100	7581	± 62
5	5248	± 95	5814	±124	7194	±158	7920	±117
6	NO DATA							

TABLE 6

MEAN SALARIES AND CONFIDENCE INTERVAL FOR FEMALE NONTEACHERS (STATED IN DOLLARS)

	Years of Experience							
	0-1		2-5		6-15		16 and over	
Years of Training	Mean	Interval	Mean	Interval	Mean	Interval	Mean	Interval
1	2580	± 56	3011	± 49	3573	± 78	3952	±213
2	3544	±288	3764	±125	4029	±326	4500	±515
3	3534	± 66	3908	±130	4213	±183	4712	±369
4	3904	±150	4476	± 90	4851	±275	5386	±647
5	4160	±258	4518	±290	4973	±418	5257	±443
6				NO DATA				

experience (cell 4-A), the mean of the underlying population is estimated, with 95% confidence, to be within $\pm$\$51.00 of the sample mean of \$4892.00

Tables 7 through 10 present these same intervals in relative terms. In this case, the interval measures the precision, at the 95% level, of the mean estimate as a percentage of the sample mean; this measure is calculated from the following formula:[1]

$$\text{precision} = t_{.975}(v) = \frac{\pm t_{.975}\, s_{\bar{x}}\ (100)}{\bar{x}}$$

where:

$t_{.975}$ = tabled "t" value for n - 1 degrees of freedom

$\bar{x}$ = the sample mean

$s_{\bar{x}}$ = the estimated standard error of mean

v = coefficient of variation

Of interest in these tables is the fact that precision ranges from $\pm$.4% (female teachers, cell 1-C) to $\pm$18.2% (male nonteachers, cell 2-D). When $t_{.975}(v)$ equals $\pm$.4%, the inference is that the sample mean must almost

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[1]Morris H. Hansen, William N. Hurwitz, and William G. Madow, Sample Survey Methods and Theory (New York: John Wiley & Sons, Inc., 1953), p. 124-125.

TABLE 7

PRECISION OF SAMPLE ESTIMATES OF POPULATION MEAN SALARIES.* - MALE TEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Interval (%)	Interval (%)	Interval (%)	Interval (%)
1	±1.5	±1.7	±2.0	±3.7
2	±1.5	±2.5	±1.8	±3.5
3	±2.8	±3.2	±2.4	±2.3
4	±2.1	±1.7	±1.3	±1.1
5	±1.4	±2.3	±1.3	±1.5
6	±2.9	±4.0	±2.5	±1.6

*Calculated from: $\dfrac{t_{.975} \times \dfrac{s}{\sqrt{n}} \times 100}{\bar{x}}$

TABLE 8

PRECISION OF SAMPLE ESTIMATES OF POPULATION MEAN SALARIES.* - MALE NONTEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Interval (%)	Interval (%)	Interval (%)	Interval (%)
1	± 3.2	± 2.2	± 3.1	± 7.5
2	± 5.4	± 2.8	± 4.0	±18.2
3	±10.5	± 5.8	± 4.4	± 4.4
4	± 3.9	± 1.8	± 1.6	± 5.2
5	±11.7	± 8.2	± 5.0	±12.0
6	± 6.4	± 5.2	± 5.7	±12.0

*Calculated from: $\dfrac{t_{.975} \times \dfrac{s}{\sqrt{n}}}{\bar{x}} \times 100$

TABLE 9

PRECISION OF SAMPLE ESTIMATES OF POPULATION MEAN SALARIES.* - FEMALE TEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Interval (%)	Interval (%)	Interval (%)	Interval (%)
1	± .5	± .5	± .4	± .7
2	±1.0	±1.2	±1.0	±1.3
3	±2.7	±2.8	±2.5	±2.1
4	±1.1	±1.3	±1.5	± .8
5	±1.8	±2.1	±2.2	±1.5
6		NO DATA		

*Calculated from: $\dfrac{t_{.975} \times \dfrac{s}{\sqrt{n}} \times 100}{\bar{x}}$

TABLE 10

PRECISION OF SAMPLE ESTIMATES OF POPULATION MEAN SALARIES.* - FEMALE NONTEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Interval (%)	Interval (%)	Interval (%)	Interval (%)
1	± 2.2	± 1.6	± 2.2	± 5.4
2	± 8.1	± 3.3	± 8.1	±11.4
3	± 1.9	± 5.3	± 4.5	± 7.8
4	± 3.8	± 2.0	± 5.7	±12.0
5	± 6.2	± 6.4	± 8.4	± 8.4
6		NO DATA		

*Calculated from: $\dfrac{t_{.975} \times \dfrac{s}{\sqrt{n}}}{\overline{x}} \times 100$

TABLE 11

FREQUENCY DISTRIBUTIONS OF THE PRECISION* OF SAMPLE ESTIMATES OF POPULATION MEAN SALARIES

Precision Interval ($\pm$%)	Teachers		Nonteachers	
	Male	Female	Male	Female
18-20			1	
15-17				
12-14			2	1
9-11			2	1
6-8			5	8
3-5	8	1	8	4
0-2	10	19	6	6
Total	24	20	24	20

*Calculated from: $\dfrac{t_{.975} \times \dfrac{s}{\sqrt{n}} \times 100}{\overline{x}}$

exactly coincide with the population mean. However, when $t_{.975}v$ equals $\pm18\%$, the population estimate is much less precise and may be of little value. While the importance of the precision of an estimate depends on the consequence of an error in estimate, it appears that in this study a precision of from 5% to 10% is adequate to uncover important differences in salaries between teachers and nonteachers.

While the question of "important difference" must be a value judgment, it would appear that an estimate more precise than $\pm5\%$ would have little economic value. For example, if starting salaries for male teachers and nonteachers with Bachelor's Degrees are estimated to be approximately $4800.00 per year, on the average, a 5% error in this estimate (at the 95% level) locates the average within approximately $20 per month. For administrative purposes, such as setting starting salaries or predicting revenue needs, it would seem that information as precise as this would be adequate. However, for the higher salary levels that result from extensive experience, the required precision in the mean estimates

could probably be lowered. This assumption follows from an argument such as: while differences in starting salaries may have an important effect on persons entering the position, the importance of differences in salaries diminishes once they are firmly established in their occupations.

In general, the estimates of average salaries for most groups are quite accurate. For both male and female teachers the estimates are all below ±5%; for nonteachers, the estimates range from ±1.6% to ±18.2%. These values are recorded in 5% increments in Table 11, which shows the frequency of cases in each precision interval.

As will be noted later in the section dealing with the "t" test, a lack of precision in the mean estimates lowers the ability of the test to discern true differences in the population means if they exist. This effect on the "t" test is likely to exist in those cases where the precision is lowest. An example of this occurs in cell 2-D of Table 19. In this instance the mean difference is $468.00 and is considered not significant. The precision of the nonteacher mean estimate in this case is ±18.2% and is the probably cause of the lack of significance

in the "t" test. Other instances where the lack of precision in the male nonteacher mean estimates has probably affected the results of the "t" test occur in cells 5-A through 5-D and cell 6-D in Table 19.

Variance Ratios and Coefficients of Variation

The statistical measures presented in this section deal with the estimated variability of the underlying populations. They are included in order to provide (1) a description of the nature of the salary distributions under consideration and (2) a discussion of some of the economic considerations that are associated with salary variability.

Variance Ratio or "F" Test

The results of these tests are presented in Tables 12 and 13. The values indicate whether it is likely that the observed differences between the variances of the samples being compared could arise from chance factors alone, or from real differences in the variances of the underlying populations involved.

These values are calculated from a test of significance known as the "F" of variance ratio test. In this test, the sample variances are placed in a ratio, with the larger value in the numerator. The value of the ratio is then

TABLE 12

VARIANCE RATIO TEST RESULTS FOR MALES IN TEACHING AND NONTEACHING

Years of Training	Years of Experience			
	0-1	2-5	6-15	16 and over
1	3.15*	3.46*	9.96*	7.61*
2	1.81	1.37	5.11*	2.65*
3	1.27	2.25*	3.00*	3.24*
4	3.72*	2.49*	4.33*	7.40*
5	4.96*	4.88*	6.74*	13.05*
6	1.19	1.71	2.87*	5.05*

*Significant at the 95% level

TABLE 13

VARIANCE RATIO TEST RESULTS FOR FEMALES IN TEACHING AND NONTEACHING

Years of Training	Years of Experience			
	0-1	2-5	6-15	16 and over
1	6.21*	3.09*	2.35*	2.17*
2	8.97*	1.22	2.24*	1.89*
3	1.16	1.49	1.07	2.26
4	2.44*	1.08	1.96*	4.86*
5	1.12	2.23*	1.82	2.30*
6	NO DATA			

*Significant at the 95% level

calculated and compared to a tabled value of "F" appropriate to the sample sizes involved. As an example of this, the "F" value calculated from the sample variances of the male teacher and nonteacher groups in call 1-A (Table 12) is 3.15 and is significant at the 95% level. The actual values in this calculation were $F = \frac{502^2}{283^2}$, with the sample variance of the nonteachers in the numerator. From this, we can infer that the population variance of nonteachers in this category is significantly different from the population variance for teachers.

In the tabled cells marked with an asterisk the size of the ratio indicates, with 95% confidence, that it is unlikely that the sample variances being compared arose from samples drawn from populations with similar variances.

Study of these tables shows that significant differences in sample variances occurred in 32 out of 44 comparisons. For males the ratio is 19/24. For females the ratio is 13/20. In every case the nonteacher sample had the larger variance. This suggests clearly that a significantly greater range or variability exists in salaries of the nonteaching occupations sampled by this study.

If one examines the patterns brought out by the cell location of the asterisks in these tables certain

interesting conclusions are suggested. For example, significant differences were found in every cell for one year of training. This suggests that, for non-teachers in this category, salaries are significantly more variable. This is confirmed by an examination of the frequency tables that appear in the appendix. These tables show clearly the range and dispersion of the salaries in this category. In contrast, the "F" tests proved non-significant in every cell for females with 3 years training. In this category, the sample results suggest that no apparent difference exists in the variability of the salary distributions of teachers and nonteachers.

Coefficient of Variation

Where the "F" ratio is a useful statistic for comparing the estimated population variability in absolute terms, the coefficient of variation (v) allows a comparison in relationship $\frac{\sigma}{\mu}$ and is calculated by putting the sample standard deviation in ratio with the sample mean (i.e., $v = \frac{s}{x}$).

The coefficient of variation has been included in this section in Tables 14 through 17, in order to provide

TABLE 14

COEFFICIENTS OF VARIATION (v)* OF THE ESTIMATED POPULATION PARAMETERS $\frac{\sigma}{\mu}$
MALE NONTEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	v (%)	v (%)	v (%)	v (%)
1	16.4	19.5	31.3	40.3
2	9.9	12.4	24.0	25.4
3	10.0	19.1	22.5	16.5
4	11.2	15.3	21.1	26.0
5	9.4	20.3	24.9	36.5
6	4.0	11.3	21.5	26.3

*Calculated from: $v = \frac{s}{\bar{x}} \times 100$

TABLE 15

COEFFICIENTS OF VARIATION (v)*OF THE ESTIMATED POPULATION PARAMETERS $\frac{\sigma}{\mu}$
MALE TEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	v (%)	v (%)	v (%)	v (%)
1	9.0	11.1	12.2	19.7
2	7.1	13.5	10.5	14.4
3	9.4	12.9	13.6	9.6
4	5.8	10.5	11.4	10.4
5	4.4	9.8	10.1	10.6
6	4.7	10.2	14.3	12.5

*Calculated from: $v = \frac{s}{\overline{x}} \times 100$

TABLE 16

COEFFICIENTS OF VARIATION (v)*OF THE ESTIMATED POPULATION PARAMETERS $\frac{\sigma}{\mu}$
FEMALE TEACHERS

	Years of Experience			
	0–1	2–5	6–15	16 and over
Years of Training	v (%)	v (%)	v (%)	v (%)
1	6.1	8.6	9.3	10.9
2	6.7	8.9	10.1	9.9
3	6.0	11.7	12.4	10.3
4	4.6	7.6	10.4	6.7
5	4.2	6.3	7.8	6.4
6	NO DATA		9.7	6.8

*Calculated from: $v = \frac{s}{\bar{x}} \times 100$

TABLE 17

COEFFICIENTS OF VARIATION (v)* OF THE ESTIMATED POPULATION PARAMETERS $\frac{\sigma}{\mu}$
FEMALE NONTEACHERS

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	v (%)	v (%)	v (%)	v (%)
1	18.0	17.9	17.6	19.6
2	19.7	10.6	19.1	17.0
3	6.3	11.5	16.2	9.4
4	8.9	8.9	18.1	20.8
5	5.0	12.1	15.2	14.6
6		NO DATA		

*Calculated from: $v = \frac{s}{\bar{\bar{X}}} \times 100$

TABLE 18

FREQUENCY DISTRIBUTIONS OF THE COEFFICIENTS OF VARIATION (v)*

v (%)	Teachers Male	Teachers Female	Nonteachers Male	Nonteachers Female
41-45				
36-40			2	
31-35			1	
26-30			2	
21-25			6	1
16-20	1		5	9
11-15	12	3	4	5
6-10	9	17	3	4
1-5	2	2	1	1
Total	24	22	24	20

*Calculated from: $v = \frac{s}{\bar{x}}$

a descriptive tabulation of the salary distributions of the various groups. In general, these tables show that the nonteacher groups have much greater variability in salaries. The tables are summarized in Table 18; this table shows that the estimated relative variability of the populations ranges from less than 5% to over 40%. Table 18 also points out that the relative variability is lowest for female teachers and that it increases for male teachers, female nonteachers and male nonteachers, respectively.

<u>Mean Differences in Average Earnings</u>

In achieving the primary objective of this study, i.e., the comparison of teacher and nonteacher salaries, the "t" test was the most important statistical measure used. As described in Chapter III, this test is applied to determine if differences in paired sub-sample means arise from real differences in the salary means of the underlying populations, rather than from chance factors. Thus, for example, when the salary means of female teachers and nonteachers, cell 1-A, were compared, a $482.00 difference was found; the results of the "t" test, when applied to these two sub-samples, enable one to infer that, at the 95% confidence level, the $482.00 figure is

likely to represent a real difference in the salary means of the underlying populations.

Tables 19 and 20 present the differences in sample means for each paired sub-group considered. When a cell is asterisked, it indicates that a difference of this size is not likely to occur at the 95% level of significance in samples drawn from populations with similar means; thus it can be inferred that the sample means are likely to have been drawn from dissimilar populations. In those cells not asterisked, the difference in means is considered not significant, and it is inferred that: either (1) the samples came from similar underlying populations with respect to mean salaries, or (2) the sample sizes were too small to provide useful comparisons.

The presentation of significant differences in salary means in these two tables enables one to make a range of conclusions about differences in salaries paid in comparable teaching and nonteaching occupations. the following paragraphs discuss these conclusions. Particular attention is given those results that can be stated with confidence and which, thus, are of import in comparisons of teacher and nonteacher salaries. Note is also made of those results which cannot be stated with confidence on the basis of this study.

TABLE 19

MEAN DIFFERENCES IN AVERAGE EARNINGS. MALE TEACHER AND NONTEACHER GROUPINGS
(STATED IN DOLLARS)

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Difference	Difference	Difference	Difference
1	83	232*	948*	1843*
2	109	191*	64	468
3	283	61	290	333
4	20	442*	919*	771*
5	196	412	401	452
6	1606*	1158*	1103*	591

*Significant at the 95% level

TABLE 20

MEAN DIFFERENCES IN AVERAGE EARNINGS. FEMALE TEACHER AND NONTEACHER GROUPINGS
(STATED IN DOLLARS)

	Years of Experience			
	0-1	2-5	6-15	16 and over
Years of Training	Difference	Difference	Difference	Difference
1	482*	570*	841*	894*
2	61	294*	1025*	1091*
3	434*	802*	1462*	1756*
4	916*	958*	1840*	2195*
5	1088*	1296*	2221*	2663*
6	NO DATA			

*Significant at the 95% level

The most general conclusion that can be drawn from Table 19 is this: based on the sample data, male teacher salaries appear to be either equal to or less than male nonteacher salaries. This broad conclusion is suggested by the fact that, out of the 24 comparisons represented by the table, nonteachers had higher mean salaries in 19 cases, 9 of which were found to be significant at the 95% level. Teachers, on the other hand, had higher mean salaries in only 5 cases; of these, one was found to be significant at the 95% level.

Two specific conclusions can be drawn from Table 19: (1) nonteachers apparently have higher average salaries in the groups with 1, 4 and 6 years of training; (2) either average salaries are comparable between the groups with 2, 3 and 5 years of training, or the statistical procedure used does not uncover any differences that may exist in the populations. As an example of the latter point, in the groupings with 2 years of training, the mean teacher salaries are higher than the mean non-teacher salaries in every cell. In cell 2-B the precision of the mean estimates is high and the difference significant. However, in cell 2-D the precision of the nonteacher mean estimate is low ($\pm$18%), and while the difference is

substantial, it is not significant. This suggests average teacher salaries may be higher for this category; however, one cannot formally conclude this on the basis of the statistical results. For the groups with 5 years of training a similar argument holds; in this case nonteacher mean salaries are greater in every cell, and more than $400.00 greater for the groups with B, C and D experience. Again, however, the precision of the estimates for nonteachers is generally low, with the result that an inference of "no difference" must be made with respect to the mean salaries of the underlying populations.

The results of the "t" test shown on Table 20 are much more clear-cut than those on Table 19: female teachers earn higher average salaries than female nonteachers. Of the 20 comparisons presented in the table, 19 were considered significant, with average teacher salaries greater than nonteacher salaries in every case. Of further interest in these results is the fact that the mean differences increase rather consistently in both directions; i.e., through increments of training and experience. This suggests that the amount of training and experience exerts a more direct and uniform influence on salaries paid to women than it does on salaries paid to men.

Confidence Intervals of the Mean Difference

The confidence intervals presented in this section relate to the cells in Tables 19 and 20, where it was determined whether or not differences in mean salaries were significant. The intervals shown on Tables 21 and 22 are the 95% confidence intervals for estimation of the true differences in the mean salaries of the populations being compared. As discussed in the first section of this chapter the size of the intervals suggest the degree of assurance one can have in drawing inferences from the data.

If the precision of the underlying estimates is low the confidence intervals increase in size to compensate for lack of reliability in the estimates. This influence of precision is reflected in the tables by the fact that the interval sizes for the mean differences in female salaries are relatively small when compared to the interval sizes for the male salary differences. An example of this is provided in a comparison between cell 4-D for females and cell 1-D for males. In this comparison the mean differences are similar in size (approximately \$1,840.00); however, the interval sizes are ±\$565.00 for males and ±\$241.00 for females.

TABLE 21

CONFIDENCE INTERVALS OF THE MEAN DIFFERENCE,* MALE TEACHERS AND NONTEACHERS
(STATED IN DOLLARS)

	Years of Experience							
	0-1		2-5		6-15		16 and over	
Years of Training	Difference	Interval	Difference	Interval	Difference	Interval	Difference	Interval
1			232	±125	948	±295	1843	±565
2			191	±166				
3								
4			442	±170	919	±206	771	±304
5								
6	1606	±326	1158	±443	1103	±484		

*Where the mean difference was determined not significant the entry is omitted.

TABLE 22

CONFIDENCE INTERVALS OF THE MEAN DIFFERENCE.* FEMALE TEACHERS AND NONTEACHERS
(STATED IN DOLLARS)

	Years of Experience							
	0-1		2-5		6-15		16 and over	
Years of Training	Difference	Interval	Difference	Interval	Difference	Interval	Difference	Interval
1	482	± 45	570	± 43	841	± 59	894	±153
2			249	±123	1025	±229	1091	±384
3	434	±123	802	±189	1462	±232	1756	±474
4	916	±125	958	±113	1840	±241	2195	±327
5	1088	±220	1296	±258	2221	±357	2663	±120
6	NO DATA							

*Where the mean difference was determined not significant the entry is omitted.

In general, the confidence intervals presented in Tables 21 and 22 do not modify the conclusions drawn from Tables 19 and 20. Instead they confirm (1) the probable existence of significant differences in mean salaries of the underlying populations; (2) in particular, they underscore the substantial salary differences that exist for females.

Conclusion

The major results of this study have been presented in detail in the sections of this chapter dealing with variability, and with the mean differences between sub-groups and their significance. In general, it may be said that the results of the variance tests indicate that salary distributions are considerably more variable for nonteachers than they are for teachers. Likewise, results of the calculation of the mean differences and their significance suggest that female teachers earn more than female nonteachers, while male nonteachers earn more than male teachers; evidence in support of the statement about female salaries is much stronger than it is for male salaries.

CHAPTER V

SUMMARY

In this chapter, a general review of the study is presented together with a critique of the procedures followed. On the basis of this critique, two sampling plans which would correct the weaknesses of this study are examined; these plans, together with the information provided by this study, should prove useful in any further work undertaken in this area.

Review

It was the purpose of this study to determine if significant differences existed in the annual salaries paid to teachers and nonteachers in Alberta. To achieve this purpose, the mean salaries of samples drawn from teaching and comparable nonteaching occupations were compared. The procedure used was the "t" test which permits a probability statement about the likelihood of obtaining a difference in sample means as large as the one observed. This

test sets up a null hypothesis which assumes that no difference exists between the population means. If a difference as large as the one observed could occur by chance less than five times in one hundred, when drawn from the same population, the calculated "t" value was considered significant and the null hypothesis was rejected. Accordingly, it was inferred that the samples were drawn from populations with different means. When a significant difference did arise, a confidence band around that difference was calculated; this confidence band states that there is a 95% chance that the true difference lies within the interval delineated by the band.

Critique

The statistical procedures outlined above require that certain assumptions be met with respect both to the underlying populations and to the manner in which samples are drawn. In particular, they require (a) that the populations be normally distributed with similar variances, and (b) that samples be randomly and independently drawn from these populations.

In this study, it appears that these assumptions have not been met; the results must, therefore, be evaluated with some degree of qualification, depending on the extent of the violations in particular cases. When sample sizes were large and the variances reasonably similar, the results should be reliable. This is supported by C.A. Boneau's study of the "t" distribution;[1] it determined that the assumptions of the "t" test could be violated and that only extreme disparities in combinations of sample size and population variance would significantly affect its suitability as a comparison test of sample means.

However, in a number of instances it appears that the data used in this study is at or beyond the extremes specified by Boneau; thus, some results are unreliable. This problem arose because of a faulty sampling plan that led to sample sizes for the nonteacher groups that were disproportionately small in relation to their respective estimated population variances.

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[1]Boneau, _loc_. _cit_.

These considerations, together with the fact that small samples generate extremely wide confidence bands, suggest that control of sample size is of vital importance in a study of this kind. A number of approaches are possible in dealing with this problem; two will be brought out in the following discussion.

Recommendations

If resources are unlimited, it is possible to determine sample sizes that will make the "t" test sensitive to differences greater than a predetermined amount. This approach makes the usual assumptions (normal populations and random samples) and requires answers to the following questions:

1. How large a difference (d) would it be of practical importance to find, if it exists in the population? For example, if a salary difference of less than $10 per month exists, it is of no interest. If the difference is greater than $10 per month, it is desirable to uncover it.

2. What estimate can be made for the population variance?

3. How much risk can be taken in inferring that a difference exists when it is really zero? (alpha error)

4. How much risk can be taken in deciding that a difference is zero when it is really as large as the predetermined value of d? (beta error)

When these four values have been chosen, the necessary sample sizes can be computed from the following formulas:

$$n_1 = \frac{\sigma_1^2 + \sigma_1 \sigma_2}{d^2} (Z_\alpha + Z_\beta)^2$$

$$n_2 = \frac{\sigma_2^2 + \sigma_1 \sigma_2}{d^2} (Z_\alpha + Z_\beta)^2$$

where:

n_1 = size of sample one

n_2 = size of sample two

σ_1^2 = estimated variance of population one

σ_2^2 = estimated variance of population two

d = predetermined acceptable difference in population means

Z_α = value of Z at a chosen alpha level

Z_β = value of Z at a chosen beta level

An example of the use of these formulas will show their application and indicate their effects on the data in a study of this kind. From the subgroups of male teachers and nonteachers with three years of training and Group A of experience, one estimates the population variances to be \$152,100.00 and \$193,600.00, respectively. One considers a difference in annual salaries greater than \$100.00 to be important and wishes to draw samples from these populations that are large enough to discern such a difference if it exists. One is further willing to conclude, in 5% of the cases, that a difference of as much as \$100.00 prevails when in fact no difference exists (alpha error). Lastly, one is willing to conclude in 20% of cases that no difference is present when in fact the true difference is greater than \$100.00 (beta error).

With these decisions and estimates made,[2] one calculates the sample size as follows:

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[2]The point of emphasis here is that of the need for a priori estimates of population parameters. In this regard the sample estimates of population variance developed in this study should prove useful.

$$n_1 = \frac{(390)^2 + (390 + 440)}{100^2} (1.96 + .842)^2 = 263$$

$$n_2 = \frac{(390 + 440) + (440)^2}{100^2} (1.96 + .842)^2 = 295$$

The result is that, with samples of this size, a difference of as little as $100.00 in the mean salaries of these two subgroups would have proven significant.[3]

If resources are limited, the problem becomes one of choosing a sampling plan in which a fixed number of sample data points are utilized to give maximum precision to population estimates. A solution to this problem is provided by a stratified sampling plan that divides the population into strata so that the elementary units in each strata are as homogeneous as possible. Once the strata are defined, it then makes use of estimates of

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[3]In this example, the observed difference in sample means was $283.00 and was considered not significant. In this case, the sample sizes for teachers and nonteachers were 45 and 6, respectively.

population characteristics to determine the sample size of each stratum. Probability mechanisms are maintained in the plan by ensuring that the samples are randomly and independently drawn for each stratum; follow-up methods are used to ensure representativeness.[4]

In specific terms, a suitable plan would use the results of this study, together with estimates of population size, for each stratum. A total sample size n would be established which would be allocated to each stratum according to the formula:[5]

$$\text{opt. } n_h = \frac{N_h S_h}{\sum^{L} N_h S_h} n$$

where:

N_h = estimate of population size for stratum h

S_h = estimate of population standard deviation for stratum h

n = size of total sample

The result is that no other combination of subsample size will yield a smaller over-all estimate of the total population sampling variance of the mean.

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[4]Hansen, Hurwitz, and Madow, *op. cit.*, p. 473-475.

[5]*Ibid.*, p. 209.

In this study, the optimizing problem is complicated by the fact that the focus of interest is that of comparing paired strata of teachers and nonteachers. This requires that the allocations of elementary units be optimized in such a way that the sampling variances between paired strata (i.e., between teacher and nonteacher groupings) be taken into account. A solution to this problem is effected by combining the paired teacher and nonteacher groups into a new stratum that reflects the population characteristics of both groups. From these strata, the optimum allocation of the total sample is then determined from the above formula. Once the optimum sample sizes for each combined stratum are established, the data points allocated to that stratum can then be apportioned between the teacher and nonteacher subpopulations. Again, the above optimizing formula is used.

Conclusion

The main weakness of this study is that its sampling plan has led, in some cases, to unusable results.[6]

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[6]Since the results of this study are fully presented in Chapter IV, they are not repeated here.

This is attributable to the fact that some sample sizes were too small to yield precise estimates of population parameters. Had more attention been given this problem, and had a more refined sampling plan, such as one of those outlined in the foregoing recommendation, been applied, the results would have been more conclusive.

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APPENDIX

APPENDIX A

LIST OF TABLES

TABLE I

FREQUENCY DISTRIBUTIONS OF ANNUAL SALARIES OF MALE TEACHERS GROUPED BY YEARS OF TRAINING AND EXPERIENCE

	FORMAL TRAINING (YEARS)																							
	1				2				3				4				5				6			
	Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)			
ANNUAL SALARIES $	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+
16,000 & Over																								
15,800 - 15,999																								
15,600 - 15,799																								
15,400 - 15,599																								
15,200 - 15,399																								
15,000 - 15,199																								
14,800 - 14,999																								
14,600 - 14,799																								
14,400 - 14,599																								
14,200 - 14,399																								
14,000 - 14,199																							1	
13,800 - 13,999																								
13,600 - 13,799																								
13,400 - 13,599																								
13,200 - 13,399																							2	
13,000 - 13,199																								3
12,800 - 12,999																								
12,600 - 12,799																								
12,400 - 12,599																								
12,200 - 12,399																							1	
12,000 - 12,199																1								
11,800 - 11,999																								2
11,600 - 11,799																								2
11,400 - 11,599																				1				5
11,200 - 11,399																			1	1				3
11,000 - 11,199																							1	2
10,800 - 10,999																				1				1
10,600 - 10,799				1												2				3				7
10,400 - 10,599																				[illegible]				7
10,200 - 10,399																1				4				12
10,000 - 10,199											1					4				3			4	2
9,800 - 9,999																6			3	4			6	11
9,600 - 9,799																5			1	11			3	6
9,400 - 9,599															3	11			5	28			8	[illegible]
9,200 - 9,399								1							1	14			3	14			7	13
9,000 - 9,199															4	17			8	15			5	5
8,800 - 8,999															6	17			12	12			11	[illegible]
8,600 - 8,799															10	25			8	11			2	[illegible]
8,400 - 8,599											2	1		1	12	28		1	16	6		1	11	11
8,200 - 8,399				1				1			2	3			[illegible]	21			12	17			7	11
8,000 - 8,199				1										1	10	18			25	14			15	[illegible]
7,800 - 7,999				2				1			1	2			10	42			22	16		1	7	[illegible]
7,600 - 7,799								1			4	[illegible]			21	27		2	32	17			2	1
7,400 - 7,599				1				2			2	3		1	34	[illegible]		2	16	1			6	2
7,200 - 7,399				1							5	3		1	[illegible]	31			10	4			8	1
7,000 - 7,199				[illegible]				4			11	[illegible]			21	[illegible]		1	21	6		2	6	4
6,800 - 6,999				[illegible]			2				9	7		3	14	7			18	1		6	3	2
6,600 - 6,799				1			1	3		1	[illegible]	8		[illegible]	[illegible]	3		5	5			[illegible]	3	
6,400 - 6,599				[illegible]			[illegible]	1		2	11	10		4	12	4		9	3	2		[illegible]	1	
6,200 - 6,399				1		1	[illegible]	[illegible]		[illegible]	2	[illegible]		14	16			11	2		1	1	1	
6,000 - 6,199				[illegible]		3	11	[illegible]			[illegible]	4	1	12	7			8				3		
5,800 - 5,999			[illegible]	[illegible]		1	12	1			13	2	1	14	13		1	12				5		
5,600 - 5,799			[illegible]	[illegible]			12	4			10	1		23	3	1	6	14			3			
5,400 - 5,599				[illegible]		1	[illegible]	17		3	5	1	8	24	3		10	2			6			
5,200 - 5,399						[illegible]	21	9		4	4	1	7	[illegible]	1		13	2			2	1		
5,000 - 5,199			[illegible]	[illegible]		8	12	1	3	[illegible]	6		23	7			12	1						
4,800 - 4,999		[illegible]	11	11		10	7	2		[illegible]	4		37	9										
4,600 - 4,799		[illegible]	[illegible]	8		1	1		[illegible]	6	1		42	1										
4,400 - 4,599	1	[illegible]	[illegible]	31		11	5		[illegible]	3			3											
4,200 - 4,399		[illegible]	[illegible]	1	4	10	2		[illegible]	7														
4,000 - 4,199				3	11	6	1		7	2														
3,800 - 3,999	[illegible]				1	[illegible]			8	1														
3,600 - 3,799					[illegible]	[illegible]			10															
3,400 - 3,599					26	3																		
3,200 - 3,399					9																			
3,000 - 3,199																								
2,800 - 2,999																								
2,600 - 2,799																								
2,400 - 2,599																								
2,200 - 2,399																								
2,000 - 2,199																								
2,000 & Under																								
SAMPLE SIZE	[illegible]	178	141	113	87	81	125	67	45	64	[illegible]	72	122	142	313	[illegible]	42	[illegible]	223	178	[illegible]	[illegible]	[illegible]	[illegible]
MEAN	3142	[illegible]	[illegible]	[illegible]	3656	[illegible]	[illegible]	[illegible]	[illegible]	5091	[illegible]	6741	[illegible]	5116	7525	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
STD. DEV.	283	[illegible]	556	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	255	571	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II

FREQUENCY DISTRIBUTIONS OF ANNUAL SALARIES OF MALE NONTEACHERS GROUPED BY YEARS OF TRAINING AND EXPERIENCE

ANNUAL SALARIES $	FORMAL TRAINING (YEARS) 1				2				3				4				5				6			
	Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)			
	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+
16,000 & Over			1	1											1					3			1	
15,800 - 15,999															1	1								
15,600 - 15,799				1																				
15,400 - 15,599															1									
15,200 - 15,399																								
15,000 - 15,199			1	2			1																1	2
14,800 - 14,999																3			1					
14,600 - 14,799															1	1								
14,400 - 14,599																								
14,200 - 14,399																								
14,000 - 14,199																								1
13,800 - 13,999																								
13,600 - 13,799																								
13,400 - 13,599				1																1				
13,200 - 13,399															1	1								
13,000 - 13,199															1	1			1				1	1
12,800 - 12,999															1	1								
12,600 - 12,799															1									
12,400 - 12,599																2								
12,200 - 12,399																			1					1
12,000 - 12,199			1	2											2	1			3	3			2	
11,800 - 11,999																1								7
11,600 - 11,799																1			1					
11,400 - 11,599																			1	1			1	
11,200 - 11,399			1												4	1								
11,000 - 11,199				1											3	2			5	1			1	
10,800 - 10,999			1												6	1			2				7	3
10,600 - 10,799															4	3				1			2	
10,400 - 10,599			1	1											5	2			3	2			7	
10,200 - 10,399			1	1											6	3		1					1	
10,000 - 10,199			2	2							4	1			16	3		1	2				2	1
9,800 - 9,999											2				10	3			3				1	
9,600 - 9,799				3								1			9	4			1	2			5	
9,400 - 9,599			1	1			1								17	1			4			1	1	
9,200 - 9,399											1				17	2							2	2
9,000 - 9,199			6	1			1				1	3		1	36	4				1		1	2	
8,800 - 8,999			1	1								1			21	4			1			1	4	1
8,600 - 8,799			4	2										3	28	4			9	1			4	
8,400 - 8,599			8	1			1				4			3	[illegible]	4		1	3	2		2	4	
8,200 - 8,399			3	2							4	9		1	37	2			4	1			2	
8,000 - 8,199		1	5	8			1	1						2	32	2			4	2		2	1	
7,800 - 7,999			2	3						1	3			1	19	10		1	1	4		3	3	3
7,600 - 7,799			4	4							5	2			28	3						1	2	1
7,400 - 7,599			6	1			1			1	4	5		4	33	3		1	4		1		3	1
7,200 - 7,399			8	2							10	4		2	21	2			4		2	4	1	2
7,000 - 7,199		1	7	5			3				3	5		15	33	9		1	5	2		1		
6,800 - 6,999			7	2			1	1		1	1		1	28	14	3		3	6	1	1		1	
6,600 - 6,799			10	4			4	1			2	2		21	10			1				1		1
6,400 - 6,599			9	3				1		1	5	5		29	11			1	4	2		3		
6,200 - 6,399			7	2			6			3	8	10		12	13	2	1	5	3	3				
6,000 - 6,199		1	25	13			6	1		2	3	1		16	2	3		2	2	1				
5,800 - 5,999		2	15	4			2			2	5	2	1	2	2				4	1				
5,600 - 5,799		2	30	2		1	4	1		2	5	2		8	5	2		2	1	1				
5,400 - 5,599		7	27	7		4	20			3	6	1	3	17	14	1		4	7	2				
5,200 - 5,399		4	34	3		2	10			7	3	1	5	15	2	2	3		2					
5,000 - 5,199		14	40	15		11	30		1	2	3	1	4	12		1	1	2	1					
4,800 - 4,999		25	37	3		4	18	1	1	4	2	1	1	2										
4,600 - 4,799		26	35	4		10	4		1	3	2		1	5										
4,400 - 4,599		13	25	2		4	11			2	3		4	3										
4,200 - 4,399	1	14	23	4	1	17	11	2		3	5		2	2										
4,000 - 4,199	1	18	21		2	7	3		3	3	2		1	2										
3,800 - 3,999	9	21	7			31	2			1			2	4										
3,600 - 3,799	12	31	6		5	8				3														
3,400 - 3,599	4	28	11		3	1		1																
3,200 - 3,399	17	18	4		2	2																		
3,000 - 3,199	[illegible]	22	1		2																			
2,800 - 2,999	11	5																						
2,600 - 2,799	5	10																						
2,400 - 2,599	13	4																						
2,200 - 2,399	9																							
2,000 - 2,199																								
2,000 & Under																								
SAMPLE SIZE	102	301	453	114	15	167	142	10	6	44	102	57	34	224	517	100	5	26	91	38	4	21	57	21
MEAN	3059	4,020	5510	7020	3547	4,291	5371	5620	4416	5157	6667	7032	4712	6158	8344	8445	5320	6,550	[illegible]	9147	7175	7690	9066	10,080
STD. DEV.	506	782	1755	2232	350	523	1224	1429	440	785	1285	1171	[illegible]	915	1742	2321	521	1350	[illegible]	3,442	237	871	2015	2651

TABLE III

FREQUENCY DISTRIBUTIONS OF ANNUAL SALARIES OF FEMALE TEACHERS GROUPED BY YEARS OF TRAINING AND EXPERIENCE

ANNUAL SALARIES $	FORMAL TRAINING (YEARS)																							
	1				2				3				4				5				6			
	Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)			
	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+
16,000 & Over																								
15,800 - 15,999																								
15,600 - 15,799																								
15,400 - 15,599																								
15,200 - 15,399																								
15,000 - 15,199																								
14,800 - 14,999																								
14,600 - 14,799																								
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11,200 - 11,399																								
11,000 - 11,199																								
10,800 - 10,999																								
10,600 - 10,799																								
10,400 - 10,599																								1
10,200 - 10,399																								
10,000 - 10,199																								
9,800 - 9,999																								2
9,600 - 9,799																1								1
9,400 - 9,599																1				1				
9,200 - 9,399																1				1				1
9,000 - 9,199																2							2	2
8,800 - 8,999																1				1				
8,600 - 8,799																4				4				11
8,400 - 8,599																8			1	1			1	17
8,200 - 8,399												1			3	14				16				7
8,000 - 8,199															2	11			1	14			3	10
7,800 - 7,999												2			6	15			9	10			3	4
7,600 - 7,799								2			2	5			8	45			7	11			2	1
7,400 - 7,599								1				2			17	61			3	4	NO		1	
7,200 - 7,399				3				1				7			14	44			5	2			5	
7,000 - 7,199								1				6			13	14			4	1			2	2
6,800 - 6,999				4			1	4			3	9			16	10			11	3	DATA		2	
6,600 - 6,799				3			1	5			3	5			16	4		1	4				[illegible]	
6,400 - 6,599				2			2	5			7	9		2	21	9		2	3	1				
6,200 - 6,399				14			9	13			6	15		5	18			3	2				1	
6,000 - 6,199			1	12			7	16		2	15	4		11	12			8						
5,800 - 5,999			4	25			16	30		2	10	6		15	10			5	1					
5,600 - 5,799			9	19			27	28		1	8	3		19	9		3	12						
5,400 - 5,599			2[illegible]	78			55	66		5	13	4	2	3[illegible]	6		2	3						
5,200 - 5,399			34	54			66	26		5	8	4	4	37	3		10	3						
5,000 - 5,199			78	113		2	52	14		5	2		14	14			8	1						
4,800 - 4,999			1[illegible]	115		5	71	10		6	12		19	13										
4,600 - 4,799		2	317	1[illegible]	1	16	15	5	3	13	4		35	6										
4,400 - 4,599		11	410	246		17	55	6		4	4		1											
4,200 - 4,399		36	210	35		42	28	2	3	11														
4,000 - 4,199		93	257	34	3	35	9		9	2	1													
3,800 - 3,999	3	132	120	9	24	50			15	5														
3,600 - 3,799	[illegible]	231	62	3	31	24																		
3,400 - 3,599	36	252	22		60	17			1															
3,200 - 3,399	150	214	6		62	1																		
3,000 - 3,199	233	44																						
2,800 - 2,999	167																							
2,600 - 2,799																								
2,400 - 2,599																								
2,200 - 2,399																								
2,000 - 2,199																								
2,000 & Under																								
SAMPLE SIZE	546	1050	1718	956	187	216	412	229	31	68	98	95	75	144	171	262	23	36	51	75			30	64
MEAN	3062	3530	4414	4846	3433	4658	5054	5541	3106	4710	5675	[illegible]	4320	[illegible]	6641	7581	5246	5814	[illegible]	7920			[illegible]	[illegible]
STD. DEV.	187	306	410	[illegible]	[illegible]	302	514	556	240	544	704	[illegible]	222	413	672	502	219	355	544	566			[illegible]	[illegible]

TABLE IV

FREQUENCY DISTRIBUTIONS OF ANNUAL SALARIES OF FEMALE NONTEACHERS GROUPED BY YEARS OF TRAINING AND EXPERIENCE

	FORMAL TRAINING (YEARS)																							
	1				2				3				4				5				6			
	Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)				Experience (Yrs.)			
ANNUAL SALARIES $	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+	0-1	2-5	6-15	15+
16,000 & Over																								
15,800 - 15,999																								
15,600 - 15,799																								
15,400 - 15,599																								
15,200 - 15,399																								
15,000 - 15,199																								
14,800 - 14,999																								
14,600 - 14,799																								
14,400 - 14,599																								
14,200 - 14,399																								
14,000 - 14,199																								
13,800 - 13,999																								
13,600 - 13,799																								
13,400 - 13,599																								
13,200 - 13,399																								
13,000 - 13,199																								
12,800 - 12,999																								
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6,600 - 6,799					1															1				
6,400 - 6,599								1																
6,200 - 6,399				1												1			1	1				
6,000 - 6,199															1				1					
5,800 - 5,999			1				1								3	1			2					
5,600 - 5,799			1								1			2	3	2								
5,400 - 5,599										2				2	3			1	1				NO	
5,200 - 5,399				1		1	1				2	2		2	1	1				3				
5,000 - 5,199		1	2	1							1	1		4	8	2			2	3				
4,800 - 4,999		1	2				1			1	2	2		6	7	1		2	1	3				
4,600 - 4,799		3	6	3		1	4	5			4		1	24	2			3	2	1		DATA		
4,400 - 4,599		1	9	5			2	1		3	8	1		10	3	2	1	3	1					
4,200 - 4,399	2	9	18	7		2	2	1		4	7		1	12	4		1	2	2	1				
4,000 - 4,199		9	22	9	1	7	1	1	3	7	12	2	12	15	5	1	3	1	2					
3,800 - 3,999	7	18	26	6	1	11	3			11	8		7	3	6	1		1						
3,600 - 3,799	1	[illegible]	35	6	2	5	3	1	19	11	3			1	1			1						
3,400 - 3,599	7	44	[illegible]	[illegible]	10	12	1	1	22	10	5			1	1			2						
3,200 - 3,399	15	52	16	[illegible]	9	2	2		1		1													
3,000 - 3,199	29	[illegible]	24	4		1	2		1				1											
2,800 - 2,999	22	56	14	1									1											
2,600 - 2,799	44	61	15	3	1				1															
2,400 - 2,599	50	42	2				1																	
2,200 - 2,399	46	36	1																					
2,000 - 2,199	32	12	1																					
2,000 & Under	14	4																						
SAMPLE SIZE	275	471	251	54	25	42	24	11	47	49	56	8	23	78	51	14	5	16	15	14				
MEAN	2586	3011	3573	3752	3544	3164	4027	4560	3534	3908	4213	4712	3904	4476	4551	5526	4160	4518	4773	5257				
STD. DEV.	465	540	629	726	616	400	276	265	223	450	481	442	342	398	522	1120	407	545	756	762				

APPENDIX B

SPECIMEN FORMS

EMPLOYEE DATA SHEET

Age	Sex	Job Classification	Position	Experience (Years)	Training (Years)	Annual Salary
1	2	3	4	5	6	7

15303 - 78th Avenue,
Edmonton, Alberta.
Phone HU9-8263

July 27th, 1961.

Dear Sir:

Once each year the majority of school boards in Alberta sit across the bargaining tables from the Alberta Teachers' Association and negotiate a new employment contract for the teachers under their jurisdiction. Major issues that arise include salaries, sick leave, miscellaneous fringe benefits, etc. and, as is the case in many such negotiations, much friction and fiction is involved.

In order to bring some facts to the fore, the Alberta School Trustees' Association has engaged the Department of Economics of the University of Alberta to prepare a comprehensive study, a part of which, will be devoted to salary and fringe benefit comparisons between teaching and nonteaching occupations.

Under Dr. E. Hanson, I have been commissioned to prepare this phase of the study and must necessarily solicit your assistance in providing data on nonteaching occupations.

I realize this information is often closely guarded and hasten to point out that returns will be held strictly confidential. The study has been cleared with the Better Business Bureau in Edmonton and you may contact them if you desire.

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I realize further that I am asking for assistance free gratis and respectfully submit that this is justified inasmuch as copies of Dr. Hanson's report will be sent to participating companies and I am certain you will find the information valuable.

Attached is our questionnaire which we hope is self-explanatory. Our reasons for asking these specific questions arise because it is of vital importance to the study that we relate experience, education and level of responsibility.

In the teaching profession, salaries are determined specifically by the number of years of formal training beyond grade 12, the number of years of actual teaching experience and the level of responsibility, i.e., teacher, vice-principal, and superintendent. If we can get data on other professions divided in this fashion, a very valid comparison will result.

Kindly mail returns to the above address, or, if you wish, to the Department of Economics, University of Alberta, Edmonton, to the attention of the writer. If further explanations are required you are urged to contact me by phone or mail.

Yours very truly,

G.K. Palmer